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TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application Number	09/905,398
Filing Date	7/14/2001
First Named Inventor	Nace Layadi
Group Art Unit	2814
Examiner Name	Mai, Anh D.
Attorney Docket Number	Layadi 30-23 (001)

Total Number of Pages in This Submission

ENCLOSURES (check all that apply)

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| <input checked="" type="checkbox"/> Fee Transmittal Form
<input checked="" type="checkbox"/> Fee Attached
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Remarks

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm or Individual name: **David G. Maire, Esquire Reg. No. 34,865
Beusse, Brownlee, Bowdoin & Wolter, P. A.**

Signature

David G. Maire

Date

7/10/03

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FEE TRANSMITTAL for FY 2000

Patent fees are subject to annual revision.

TOTAL AMOUNT OF PAYMENT (\$ 320.00)

Complete if Known

Application Number	09/905,398
Filing Date	7/14/2001
First Named Inventor	Nace Layadi
Examiner Name	Mai, Anh D.
Group Art Unit	2814
Attorney Docket No.	Layadi 30-23 (001)

METHOD OF PAYMENT (check one)

1. ☐ The Commissioner is hereby authorized to charge indicated fees and credit any overpayments to:

Deposit Account Number
Deposit Account Name

☐ Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17

☐ Applicant claims small entity status. See 37 CFR 1.27

2. ☒ Payment Enclosed:

☒ Check ☐ Credit card ☐ Money Order ☐ Other

FEE CALCULATION

1. BASIC FILING FEE

Large Entity	Small Entity	Fee Code (\$)	Fee Code (\$)	Fee Description	Fee Paid
		101 690	201 345	Utility filing fee	<input type="text"/>
		106 310	206 155	Design filing fee	<input type="text"/>
		107 480	207 240	Plant filing fee	<input type="text"/>
		108 690	208 345	Reissue filing fee	<input type="text"/>
		114 150	214 75	Provisional filing fee	<input type="text"/>

SUBTOTAL (1) (\$ 0)

2. EXTRA CLAIM FEES

Total Claims	Extra Claims	Fee from below	Fee Paid
Independent Claims	- 20** = <input type="text"/> X <input type="text"/>	= <input type="text"/>	<input type="text"/>
Multiple Dependent	- 3** = <input type="text"/> X <input type="text"/>	= <input type="text"/>	<input type="text"/>

**or number previously paid, if greater; For Reissues, see below

Large Entity	Small Entity	Fee Code (\$)	Fee Code (\$)	Fee Description
		103 18	203 9	Claims in excess of 20
		102 78	202 39	Independent claims in excess of 3
		104 260	204 130	Multiple dependent claim, if not paid
		109 78	209 39	** Reissue independent claims over original patent
		110 18	210 9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) (\$ 0)

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity	Small Entity	Fee Code (\$)	Fee Code (\$)	Fee Description	Fee Paid
		105 130	205 65	Surcharge - late filing fee or oath	<input type="text"/>
		127 50	227 25	Surcharge - late provisional filing fee or cover sheet	<input type="text"/>
		139 130	139 130	Non-English specification	<input type="text"/>
		147 2,520	147 2,520	For filing a request for <i>ex parte</i> reexamination	<input type="text"/>
		112 920*	112 920*	Requesting publication of SIR prior to Examiner action	<input type="text"/>
		113 1,840*	113 1,840*	Requesting publication of SIR after Examiner action	<input type="text"/>
		115 110	215 55	Extension for reply within first month	<input type="text"/>
		116 380	216 190	Extension for reply within second month	<input type="text"/>
		117 870	217 435	Extension for reply within third month	<input type="text"/>
		118 1,360	218 680	Extension for reply within fourth month	<input type="text"/>
		128 1,850	228 925	Extension for reply within fifth month	<input type="text"/>
		119 300	219 150	Notice of Appeal	<input type="text"/>
		120 300	220 150	Filing a brief in support of an appeal	320.00
		121 260	221 130	Request for oral hearing	<input type="text"/>
		138 1,510	138 1,510	Petition to institute a public use proceeding	<input type="text"/>
		140 110	240 55	Petition to revive - unavoidable	<input type="text"/>
		141 1,210	241 605	Petition to revive - unintentional	<input type="text"/>
		142 1,210	242 605	Utility issue fee (or reissue)	<input type="text"/>
		143 430	243 215	Design issue fee	<input type="text"/>
		144 580	244 290	Plant issue fee	<input type="text"/>
		122 130	122 130	Petitions to the Commissioner	<input type="text"/>
		123 50	123 50	Petitions related to provisional applications	<input type="text"/>
		126 240	126 240	Submission of Information Disclosure Stmt	<input type="text"/>
		581 40	581 40	Recording each patent assignment per property (times number of properties)	<input type="text"/>
		146 690	246 345	Filing a submission after final rejection (37 CFR § 1.129(a))	<input type="text"/>
		149 690	249 345	For each additional invention to be examined (37 CFR § 1.129(b))	<input type="text"/>
		179 690	279 345	Request for Continued Examination (RCE)	<input type="text"/>
		169 900	169 900	Request for expedited examination of a design application	<input type="text"/>

Other fee (specify)

* Reduced by Basic Filing Fee Paid

SUBTOTAL (3) (\$ 320.00)

SUBMITTED BY

Name (Print/Type)	David G. Maire, Esquire	Registration No. (Attorney/Agent)	34,865	Telephone	(407) 926-7704
Signature	<i>David G. Maire</i>	Date	7/10/03		

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

#11 / Appeal Brief
7.24.03
C. Moore

Application of:

Group Art Unit: 2814

Nace Layadi, et al.

Examiner: Mai, Amh D.

Serial No.: 09/905,398

Attorney Docket: Layadi 30-23

Filed: 7/14/2001

Title: POLISH OR ETCH STOP LAYER

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APPELLANT'S BRIEF UNDER 37 CFR 1.192

This brief is in furtherance of the Notice of Appeal filed in this application on May 12, 2003.

The fee required under 37 CFR 1.17(c) is paid concurrently with the filing of this brief in accordance with the accompanying Transmittal of Appeal Brief.

This brief is transmitted in triplicate in accordance with 37 CFR 1.192(a).

1. REAL PARTY IN INTEREST - 37 CFR 1.192(c)(1)

The real party in interest in this appeal is the assignee of the present application, Agere Systems, Inc., a corporation of the State of Delaware.

2. RELATED APPEALS AND INTERFERENCES - 37 CFR 1.192(c)(2)

There is no other appeal or interference that will directly affect, or that will be directly affected by, or that will have a bearing on the Board's decision in this appeal.

3. STATUS OF CLAIMS - 37 CFR 1.192(c)(3)

Claims cancelled: 6, 8-17

(Note: two claims were erroneously numbered 16 in the original application.

Because of this mistake, no claim 18 was ever presented in the application).

Claims withdrawn but not cancelled: none.

Claims pending: 1-5, 7, 19-20 and 21.

Claims allowed: none.

Claims rejected: 1-5, 7, 19-20 and 21.

The claims on appeal are 1-5, 7, 19-20 and 21.

4. STATUS OF AMENDMENTS - 37 CFR 1.192(c)(4)

No amendment has been entered after the Final Rejection contained in the Office Communication dated 02/11/2003.

5. SUMMARY OF THE INVENTION - 37 CFR 1.192(c)(5)

The invention is a semiconductor structure including a polish etch stop layer disposed over a layer of a dielectric material in order to protect the dielectric material during the polishing of an overlying layer of metal. The polish etch stop layer may be titanium aluminum nitride (claims 1-5 and 7). Alternatively, the polish etch stop layer may be titanium nitride alloyed with carbon and having a hardness which is 30 to 35 percent greater than a hardness of titanium nitride alone (claims 19-20). These embodiments are illustrated in FIGs. 1 and 2, which show the polish stop layer 18 disposed over a dielectric layer 14 and under a metal layer 20. These embodiments are described in the specification at page 4, line 24 through page 5, line 20.

The invention is further a semiconductor structure including a titanium aluminum nitride etch stop layer disposed over a layer of metal in order to protect the metal during the etching of an overlying layer of dielectric (claim 21). This embodiment is illustrated in FIG. 3, which shows the etch stop layer 34 disposed over a metal layer 28 and under a dielectric layer 26. This embodiment is described in the specification at page 5, line 21 through page 6, line 27.

6. ISSUES - 37 CFR 1.192(c)(6)

(1) Whether claims 19 and 20 are clearly anticipated under 35 USC 102(b) by Konecni (U.S. patent 6,069,072)?

(2) Whether claims 1-5 and 7 are unpatentable under 35 USC 103(a) over Yamashita (JP patent 08-107148) in view of Meikle (U.S. patent 5,231,306)?

(3) Whether claim 21 is unpatentable under 35 USC 103(a) over Yamashita (JP patent 08-107148) in view of Meikle (U.S. patent 5,231,306)?

7. GROUPING OF CLAIMS - 37 CFR 1.192(c)(7)

The appellant agrees that claims 19 and 20 are properly grouped together in the rejection under 35 USC 102(b).

The appellant disagrees that claims 1-5 and 7 should be grouped together with claim 21 in the rejection under 35 USC 103(a). While each of these claims includes the limitation of a titanium aluminum nitride layer, in claims 1-5 and 7 this layer is disposed over a dielectric layer to protect the dielectric layer during the etching of an overlying layer of metal. Conversely, in claim 21 this layer is disposed over a metal layer to protect the metal layer during the polishing of an overlying layer of dielectric. Because the relative positioning of layers of material is technically significant in a semiconductor structure, claims 1-5 and 7 should be grouped separately from claim 21 for purposes of consideration in this appeal.

8. ARGUMENT - 37 CFR 1.192(c)(8)

Issue 1 - Whether claims 19 and 20 are clearly anticipated under 35 USC 102(b) by Konecni (U.S. patent 6,069,072)?

Konecni fails to describe the specific claim limitations of "a polish stop layer comprising titanium nitride alloyed with carbon deposited over the dielectric layer and extending into the via" and "a metal layer deposited over the polish stop layer and filling the via."

The only use of titanium nitride alloyed with carbon that is described in Konecni is with respect to the barrier layer 360 of FIG. 3 and layer 230 of FIG. 2B, which are both

disposed above a respective aluminum (metal) plug 330, 220 and which do not extend into the via. Konecni describes this use of titanium nitride alloyed with carbon in this location above the aluminum plug as being for the purpose of electromigration protection. (see column 4, lines 31-42) The Konecni disclosure fails to describe the claimed combination of titanium nitride alloyed with carbon over a dielectric layer and extending into a via below a metal layer for the purpose of a polish stop layer.

Konecni does describes a barrier layer (liner layer) 205 of FIG. 2A that extends into a via. However, Konecni describes this layer as being titanium nitride (see column 3, line 8) and not as being titanium nitride alloyed with carbon. Konecni fails to describe a layer of titanium nitride alloyed with carbon extending into a via over a dielectric layer. Further, the titanium nitride barrier layer 205 of Konecni is not a polish stop layer. That is, Konecni specifically teaches that a portion of that layer disposed outside the via and designated as 205' will be removed during a subsequent CMP process (see column 3, lines 9-11). Accordingly, Konecni teaches away from the claimed polish stop layer.

Konecni also fails to describe the specific claim limitation of "wherein the polish stop layer has a hardness which is 30 to 35 percent greater than a hardness of titanium nitride alone for protecting the dielectric layer from a chemical mechanical polishing process used to remove a portion of the metal layer deposited outside of the via." This is not an inherent characteristic of the titanium nitride alloyed with carbon that is described in Konecni, since Konecni allows the carbon content to reach 30% (column 4, line 36) for the purpose of electromigration protection, whereas the present specification and dependent claim 20 specifically limit the carbon content to no more than 20% for the purpose of a polish stop function.

Issue 2 - Whether claims 1-5 and 7 are unpatentable under 35 USC 103(a) over Yamashita (JP patent 08-107148) in view of Meikle (U.S. patent 5,231,306)?

The Examiner has failed to satisfy the burden of factually supporting the *prima facie* conclusion of obviousness as required under MPEP 2142. The Examiner admits that Yamashita fails to disclose the claim 1 limitation of "wherein said polish stop layer comprises titanium aluminum nitride." The Examiner states "Meikle teaches that TiAlN are known in the art to be used in place of TiN in semiconductor devices" and that "it would have been obvious to one having ordinary skill in the art at the time of invention

to form the polish stop layer (31) of Yamashita comprises TiAlN as taught by Meikle because TiAlN material is more resistant to diffusion than TiN."

MPEP 2143.01 provides: The mere fact that references can be combined or modified in hindsight does not render that resultant combination obvious. Rather, the prior art must also suggest the desirability of the combination (*In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990)). The fact that titanium aluminum nitride is more resistant to diffusion than titanium nitride is not indicative of the relative performance of these two materials during a polishing process. Diffusion is related to porosity of the material whereas polishing performance is related to chemical reactivity and mechanical strength. The fact that Meikle teaches that TiAlN is more resistant to diffusion than TiN provides no motivation for using titanium nitride alloyed with aluminum in place of titanium nitride as a polish stop layer.

Prima facie obviousness also requires a reasonable expectation of success. (*In re Clinton*, 188 USPQ 365) Meikle's teaching regarding the performance of TiAlN for preventing interdiffusion of silicon and aluminum at a silicon/aluminum interface provides no basis for any expectation regarding the performance of that material as a polish stop layer.

Furthermore, Meikle states at column 2, lines 35-36 that "TiAlN etches readily in NH₄OH/H₂O₂ similar to TiN." Thus Meikle provides no motivation for using TiAlN in the device of Yamashita in order to improve its polish stop performance, and thus the Examiner has failed to establish a case for *prima facie* obviousness.

Issue 3 - Whether claim 21 is unpatentable under 35 USC 103(a) over Yamashita (JP patent 08-107148) in view of Meikle (U.S. patent 5,231,306)?

The Examiner has failed to satisfy the burden of factually supporting the *prima facie* conclusion of obviousness as required under MPEP 2142.

First, the Examiner describes the teaching of Yamashita and states "wherein the barrier layer (27) function as an etch stop layer. (See Fig. 6)." This is technically incorrect, since layer 27 of Yamashita has clearly been partially etched away during the dielectric-etching step illustrated in FIG. 5. Thus, Yamashita actually teaches that the material of layer 27, which is titanium nitride, will not function as an etch stop layer.

Meikle states at column 2, lines 35-36 that "TiAlN etches readily in $\text{NH}_4\text{OH}/\text{H}_2\text{O}_2$ similar to TiN." Thus Meikle fails to recognize the significantly different etch properties of these two materials.

Accordingly, it is not proper to combine Yamashita and Meikle since the substitution of titanium nitride alloyed with aluminum from Meikle into the layer 27 of Yamashita would interfere with the etching step of FIG. 5 of Yamashita wherein a portion of that layer is intentionally removed. Thus, the combination of the teaching of Meikle into the device of Yamashita would not result in the intended structure of FIG. 6 of Yamashita, thereby destroying the intent of the Yamashita patent.

Claim 21 includes the limitations of "a layer of titanium aluminum nitride disposed on the metal layer" and "wherein the layer of titanium aluminum nitride functions as an etch stop layer upon removal of the selected portion of the dielectric layer to prevent the etching process from compromising the underlying metal layer." The combination of Yamashita and Meikle fails to establish a *prima facie* case for the obviousness of this claimed combination.

9. APPENDIX OF CLAIMS - 37 CFR 1.192(c)(9)

An appendix containing a copy of the claims involved in this appeal is provided herewith.

Respectfully submitted,

A handwritten signature in cursive script that reads "David G. Maire".

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APPENDIX OF CLAIMS

1. (Amended) A semiconductor structure comprising:
 - a substrate having a device feature formed thereon;
 - a dielectric layer disposed over said substrate and device feature and having at least one contact hole formed therein;
 - a polish stop layer disposed over the dielectric layer and extending within the contact hole;
 - a layer of metal disposed over the polish stop layer within the contact hole and forming a plug; and
 - wherein said polish stop layer comprises titanium aluminum nitride.
2. (Amended) The semiconductor structure of claim 1 and including a metal coating under said dielectric layer, said metal coating comprising a compound of titanium nitride and aluminum.
3. (Amended) The semiconductor structure of claim 2 wherein the dielectric comprises a silicon oxide.
4. The semiconductor structure of claim 3, wherein the metal coating comprises an anti-reflective coating.
5. (Amended) The semiconductor structure of claim 1, wherein the polish stop layer comprises titanium aluminum nitride with between about 5 and 20 percent by weight of aluminum.
7. The semiconductor structure of claim 2, wherein the metal coating comprises about 5 to 20 percent by weight of aluminum.

19. A semiconductor structure comprising:
a substrate layer;
a dielectric layer disposed over the substrate layer and having a via formed therein;
a polish stop layer comprising titanium nitride alloyed with carbon deposited over the dielectric layer and extending into the via;
a metal layer deposited over the polish stop layer and filling the via; and
wherein the polish stop layer has a hardness which is 30 to 35 percent greater than a hardness of titanium nitride alone for protecting the dielectric layer from a chemical mechanical polishing process used to remove a portion of the metal layer deposited outside of the via.

20. The semiconductor structure of claim 19, wherein the polish stop layer comprises titanium nitride alloyed with between 5 and 20 percent by weight carbon.

21. A semiconductor structure comprising:
a metal layer disposed on a substrate;
a layer of titanium aluminum nitride disposed on the metal layer;
a dielectric layer disposed on the layer of titanium aluminum nitride;
a patterned layer of photoresist disposed on the dielectric layer exposing a selected portion of the dielectric layer to an etching process;
wherein the layer of titanium aluminum nitride functions as an etch stop layer upon removal of the selected portion of the dielectric layer to prevent the etching process from compromising the underlying metal layer.